FIRE REGIMES ASSESSMENT FOR UPPER STRYKER RIDGE TIMBER SALE

February 1996

Stephen W. Barrett
Consulting Research Forester

INTRODUCTION

In February 1996, an assessment of historical fire regimes was conducted for an approximately 4000-acre area within the Upper Stryker Ridge Timber Sale, Stillwater State Forest. This analysis was based on DNRC data on file, field observations, and a literature review. The goal was to provide ecological perspective on the natural role of fire at both the coarse- and stand scales, for possible use in ecosystem management activities. Accordingly, the following patterns of fire history and fire regimes were documented for the Stillwater State Forest.

Coarse-scale fire patterns. Archival maps depicting post-1900 fire history in the upper Flathead Valley (on file, USDA Forest Service Region One, Missoula), including the Stillwater State Forest, reveal that tens of thousands of acres were burned, and occasionally reburned, by multiple stand replacing fires between 1910 and 1934. Stands that regenerated after large fires in 1910, 1926, 1929, 1934, and other years now heavily dominate the forest mosaic in the upper Stillwater River drainage and adjacent areas (fig. 1). These wildfires occurred during a long-term drought that apparently had been unprecedented since at least 1500 A.D. (Keen 1937, Graumlich 1987, Barrett 1995), vastly depleting old growth stands throughout much of northwestern Montana and northern Idaho.

Seral age class data (on file, Stillwater State Forest) and increment cores from a 2/12/96

field trip were used to develop a rough Master Fire Chronology for a 4000-acre portion of the sale area (table 1). Most of the forest age class mosaic apparently regenerated after 4 or 5 fires between ca. 1730 and 1922. Specifically, stand replacing fires occurred in ca.1730, 1756, 1792, 1813, and 1922, and scattered remnant trees more than 500 years old also occupy the area. Interestingly, the ca.1730 fire might represent the same major fire year that occurred on both sides of the Continental Divide in Glacier National Park (McDonald Creek and St. Mary River drainages)(Barrett et al. 1991), and in nearby Coram Experimental Forest (Sneck 1977). The last important fire near the analysis area occurred in 1922, an approximately 700 acre stand replacing fire that burned about 300 acres (8%) of the southwestern portion of the Upper Stryker Ridge Timber Sale. A large fire also burned much of the northern portion of the Stillwater State Forest in 1926. Otherwise, unlogged stands occupying much of the Forest today represent some last vestiges of old growth in the upper Flathead Valley (fig. 1).

In terms of area fire frequency, the 5 fires between ca.1730 and 1922 yield a mean fire interval (MFI) of about 50 years between significant stand replacing events in the 4000 acre examined area. This should be viewed as a conservative estimate of fire frequency because a more thorough sampling might have produced evidence of other fires. Consecutive fire intervals in this chronology ranged from about 20 years to 100 years long, and the area's last important fire occurred 73 years ago (i.e., 1922). At the mid scale, therefore, the 8 decades since the 1922 fire currently exceed by one-third the estimated mean fire interval. (The actual difference between the 2 statistics might well be more pronounced had a more comprehensive database been obtained). More important, the sale area evidently has not experienced a major fire in the last 250 years.

The age class mosaic in the analysis area is skewed toward older stands (fig. 2), perhaps in

part because of efficient fire suppression after the mid-1930s. Only about one-quarter of the mosaic is dominated by young- to mid age stands (i.e., harvest units and the 1922 age class). More than three-quarters of the mosaic currently is dominated by stands over 150 years old. Aerial photographs verify that this portion of the Stillwater State Forest contains a comparatively old mosaic displaying little heterogeneity—that is, a forest with relatively indistinct stand margins. From a fire history standpoint, this heavily skewed distribution suggests that, without harvest treatments aimed at promoting age class diversity, much of the Stillwater Forest will continue to be highly vulnerable to stand replacing fires. Without long-term fire suppression, perhaps just 30 to 50 percent of the age class mosaic would now contain old growth stands. (Note: "old growth" here refers to overmature stands in the mid- to upper limits of the fire cycle, rather than to any administratively defined term).

use in chapter 3

Stand fire patterns. The fire regimes data also were examined for the stand scale of analysis (Arno and Peterson 1983, Barrett and Arno 1988). Field observations, DNRC data on file, and interpretations from nearby studies (Sneck 1977, Antos 1977, Barrett et al. 1991) indicate that most stands on the Stillwater State Forest have experienced stand replacing fires after moderately long- to long intervals. The estimated Master Fire Chronology suggests that stand replacing fires usually recur in moist habitat types (Pfister et al. 1977) after long intervals (e.g., 150-300 yr in riparian THPL/CLUN h.t.). Data from similar sites in Glacier National Park's McDonald Creek drainage (Barrett et al. 1991), and in the Swan Valley (Antos 1977), suggest a mean interval of 200 years between replacement fires at the stand level.

Somewhat shorter fire intervals occurred in moderately moist habitat types on steep,

use in chapter IV

sheltered slopes (e.g., ABLA/CLUN, northerly aspects). However, studies indicate that more variation in fire frequency may occur in this forest zone. For example, judging from the patterns of adjoining age classes in the sale area, intervals between consecutive fires may have ranged from 80 to 200 years, with a possible average fire interval of 180 years (Barrett and Arno 1988). Similarly, samples from a mid-elevation, larch-lodgepole pine stand on nearby Big Mountain suggested a MAFI of 200 years (Barrett [unpub data on file]). The above estimates are somewhat longer than those generated by Sneck's (1977) study in larch-Douglas-fir dominated stands at lower elevations on Coram Experimental Forest. Sneck's (1977) data from the montane- and lower subalpine zones suggested that presettlement stand MFIs ranged from 120 to 150 years long. Finally, Antos' (1977) data from the Swan Valley also suggest an MFI of about 150 years between stand replacing fires on upland grand fir- and subalpine fir habitat types. For planning purposes, therefore, a stand MFI of 160 years might represent a useful index of stand fire frequency on moderately moist upland sites.

Evidence of a mixed severity fire regime also was observed on west- and southwesterly aspects in the Upper Stryker Ridge sale area. Specifically, occasional "seam-scar" trees in multi-age stands (i.e., seral component) indicated that moderate-severity fires occurred on the lower- to mid elevation drier aspects. Based on the sample locations and fire sequences in the Master Chronology, short- to moderately long fire intervals may have occurred in drier stands. Intervals between consecutive fires may have ranged from as few as 20 years to as many as 100 years long, and possibly averaging 70 years. By comparison, mixed severity fires occurred relatively frequently on lowland sites dominated by larch and lodgepole pine in Glacier National Park's North Fork Valley (Barrett et al. 1991), where MFIs ranged from 28 to 52 years long (8-stand

grand mean: 36 yr). Twelve upland stands, similar to those at mid-elevations in the Upper Stryker Ridge area, had somewhat longer MFIs ranging from 24 to 76 years in length (grand mean: 46 yr). Interpretations from Antos (1977) Swan Valley study also suggest that mixed severity fires may have averaged 50 years on relatively dry sites dominated by western larch. Given the absence of detailed site-specific data from Stryker Ridge, this 50-year stand MFI might serve as a useful index of presettlement fire frequency for the area's driest terrain.

In terms of stand tree structures and species composition, a regime of mixed severity fires promotes highly diverse landscapes because of widely varying fire frequencies, severities, and spread patterns. These fires can range from low intensity, creeping fires that kill primarily small shade-tolerant trees--and that often fail to stimulate significant seral regeneration--to severe stand replacing runs that destroy most of the stand, creating highly favorable conditions for seral tree growth and regeneration. However, both kinds of fires promote dominance by seral trees, because mature serals have greater fire resistance, and because seral regeneration has a competitive advantage in newly destroyed stands. Importantly, studies now suggest that many stands with the mixed-severity regime have missed one or two fire cycles because of long-term fire suppression (Sneck 1977, Barrett et al. 1991, Barrett 1995). By inference, therefore, the fuel buildups over the last 5 or 6 decades would promote a shift from mixed-severity- to stand replacing fires. As well, interruption of mixed severity fires on relatively productive sites can promote rapid in-growth by later successional species, threatening the structural and compositional integrity of larch-dominated stands--whether from the standpoint of fire hazard, tree growth, or maintenance of habitat for associated floral and faunal species.

Conversely, long-term fire suppression in the stand replacement regime threatens the

compositional integrity of forest mosaics at the landscape scale, rather than in individual stands. Stand succession under the stand replacement fire regime follows a much more orderly and predictable successional sequence than under the mixed severity fire regime. But mosaic diversity was assured by the potentially wide variation in fire intervals and fire sizes, rather than by varying fire severities. Stand composition and structure can vary as a result of widely varying fire intervals, which allow different time sequences for succession. For example, stands in a given habitat type that are replaced at only 100 years would be more heavily dominated by an overstory of seral species than if fires had recurred after 300 years, when stands had developed multi-layered canopies dominated by all tree species.

Fires during the presettlement era maintained much landscape diversity with respect to forest mosaics (i.e., patch sizes). Detailed fire history maps for a 60,000 acre study area in Glacier National Park (Barrett et al. 1991), and for the 7500 acre Coram Experimental Forest (Sneck 1977), indicate that stand polygons varied widely in shape and size. Sneck's (1977) fire history maps for the Coram Experimental Forest suggest that small- to moderately large burns had regenerated stands ranging from only a few acres to as many as 500 acres in size. In the North Fork Valley, mixed severity fires on relatively dry sites dominated by larch and lodgepole pine produced a complex mosaic of single- and multi-age stands that range in size from 5 acres to 700 or more acres in size (fig. 3). A random tally of the approximate sizes of 15 multi-age stands in the North Fork suggested a mean size of 200 acres per polygon. However, these lower slope stands were interspersed with larger single-age polygons (1000+ ac.) that regenerated after stand replacing runs of several thousand acres or more. Single-age stands also become more pronounced with increasing elevation and slope steepness. In the worst case scenario, that is,

wind-driven fires during severe droughts, wildfires sometimes replaced stands over tens of thousands of relatively contiguous acres. Mosaic patterns resulting from this type of fire, such as the 50,000 acre Halfmoon Fire in 1929, are represented in the maps for the McDonald Creek- and Middle Fork study areas in Glacier National Park (Barrett et al. 1991)(fig. 3).

Although severity patterns in the stand replacement fire regime have remained unchanged throughout the fire suppression era, many landscapes now have more uniformly aging mosaics in the absence of fires. Theoretically, continued fire suppression would promote larger stand replacing fires than during the presettlement era, because previous forest mosaics often contained a more diverse mix of age classes and fuels. Increasing mosaic homogeneity can encourage fires to spread over even larger expanses of terrain when occupied by contiguous old stands, for example, during the Red Bench Fire in 1988 (38,000 ac.). Such fires would serve only to reduce overall landscape diversity, perhaps for centuries. Some 1910-burned areas in northwestern Montana and northern Idaho well illustrate this concept, where vast lodgepole pine forests now dominate terrain that previously supported a much more diverse mix of stand types. (These turn-of-the-century large fires were primarily natural events, so worst-case scenarios can occur even without long-term fire suppression).

Management Implications. The fire regimes information from Upper Stryker Ridge and ecologically similar areas produce the following implications for ecologically based management. First, from a landscape scale, data on area fire cycles can help guide management by revealing the large amount of diversity that could occur under natural fire regimes, and by suggesting the amount of land area that might have been affected by fire in the absence of fire suppression. For

purposes of illustration, perhaps 15 percent of stands in the sale area had a presettlement stand MFI of 200 years, perhaps 65 percent of the area was affected by stand replacing fires after moderately long intervals (e.g. 150 yr), and the remaining 20 percent may have experienced mixed severity fires at 50-year intervals. Study area fire cycle is calculated by dividing these acreages by the estimated MFIs, producing an average of 3 acres per year burned by the long interval regime, 17 acres per year burned by the moderately long interval regime, and 16 acres per year burned by the mixed regime. When these annual means are multiplied by the approximately 65-year-long Fire Suppression Period to date (i.e., 1930-1995), the model suggests that fires would have burned roughly half the 4000 sale area between 1930 and 1995. Because timber harvesting has removed stands on an estimated 25 percent of the total area to date, the fire cycle suggests that as many as 1000 acres might be overdue for treatment at the present time. Without stand treatments that accomplish a diverse mix of overstory- and understory thinnings, wildfires might well be able to burn this theoretical "backlog" of old growth acreage.

Fire regimes data also can help guide ecologically appropriate stand prescriptions, as well as treatment scheduling. In the mixed severity fire regime, fires intervals ranged from as little as 25 years to as many as 100 years long, and may have averaged 50 years. Long-term silvicultural plans could incorporate this range in variation, both spatially and temporily, producing a matrix of stand treatments that help restore the previous level of landscape diversity. The fire history age class map depicting the sizes and shapes of stand polygons in Glacier National Park is a useful reference, because it can serve as a possible template for stand prescriptions. Specifically, the map depicts the diverse mix of stand polygons that were produced by fires on various types of terrain (fig. 3). The age class map reveals typical patch sizes, as well as variable stand structures as

reflected by the proportion of seral dominants, that existed under the mixed severity- and stand replacement fire regimes. For instance, large single-age polygons (e.g. 1000+ ac) frequently occupy steep upland slopes, whereas smaller 1-, 2- and 3-aged stands less than 500 acres in size often occur on drier, lowland slopes. The pattern of multi-age stands is highly complex, and these stands contain the most variation in stand structure and composition. For example, mixed severity fires after long intervals (50-100 yr) tended to heavily thin stands, which would be emulated by seed-tree harvests. Mixed severity fires after short intervals, especially on dry aspects, promoted heavy retention of overstory seral trees, which would be emulated by a shelterwood system. Small clearcuts could be used to tie in such units, because both fire regimes produced variable-size openings in which few trees survived. Finally, narrow stringer stands in riparian zones often persisted for centuries before being killed by severe fires, serving as valuable wildlife habitat and possible travel corridors.

Long-term silvicultural plans that incorporate some of these fire history principles can yield numerous benefits. In addition to helping to maintain overall landscape integrity and produce forest products, retention of a diverse mix of stands would also contribute to wildfire hazard reduction, now a major concern for older stands on the Stillwater State Forest.

LITERATURE CITED

Antos, J. A. 1977. Grand fir (*Abies grandis* [Dougl.] Forbes) forests of the Swan Valley, Montana. M.A. thesis, Univ. Montana, Missoula.

Arno, S. F., and T. D. Peterson. 1983. Variation in estimates of fire intervals: A closer look at fire history on the Bitterroot National Forest. USDA For. Serv. Res. Pap. INT-301.

Barrett, S. W. 1995. Coarse-scale fire history in relation to macroclimatic precipitation in the Columbia River Basin, ca. 1500-1940 A.D. Unpub. Rept. INT-92676-RJVA, on file at USDA For. Serv. Intermt. Fire Sci. Lab., Missoula MT.

____, and S. F. Arno. 1988. Increment borer methods for determining fire history in coniferous forests. USDA For. Serv. Gen. Tech. Rept. INT-142.

____, S. F. Arno, and C. H. Key. 1991. Fire regimes of western larch-lodgepole pine forests in Glacier National Park, Montana. Can. J. For. Res. 21: 1711-1720.

Graumlich, L. J. 1987. Precipitation variation in the Pacific Northwest (1675-1975) as reconstructed from tree rings. Ann. Assoc. Amer. Geog. 77(1): 19-29.

Keen, F. P. 1937. Climatic cycles in eastern Oregon indicated by tree rings. Mon. Weather Rev. 65: 183-188.

Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. USDA For. Serv. Gen. Tech. Rept. INT-34.

Sneck, K. M. 1977. The fire history of Coram Experimental Forest. M.S. thesis, Univ. Montana, Missoula

List of Figures

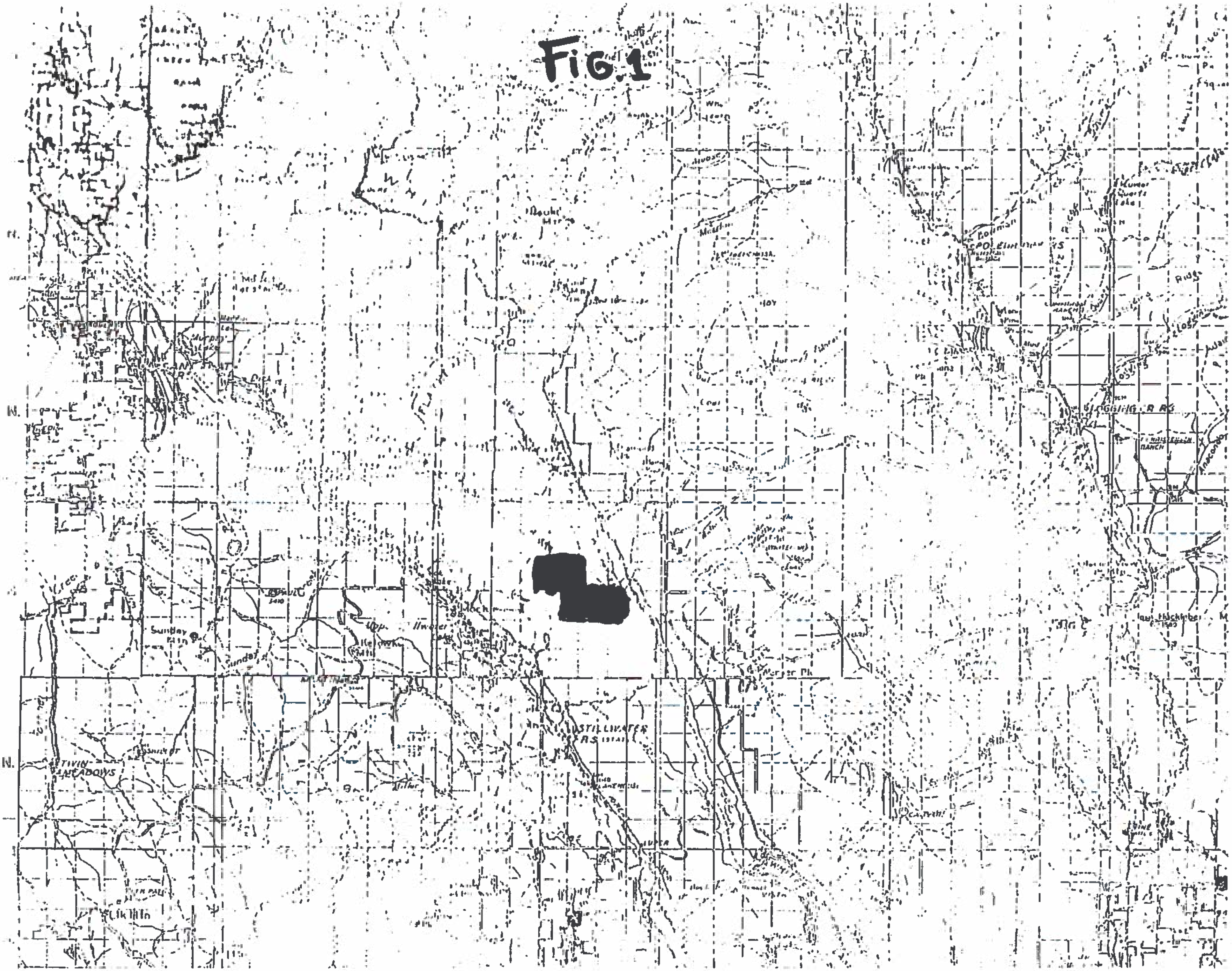


Fig. 1

Fig. 2. Forest Age Classes
Upper Stryker Ridge Timber Sale

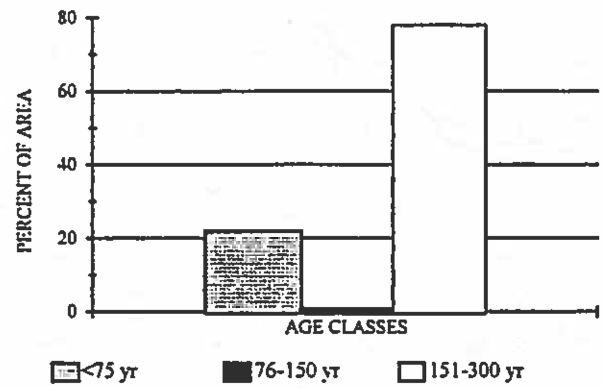
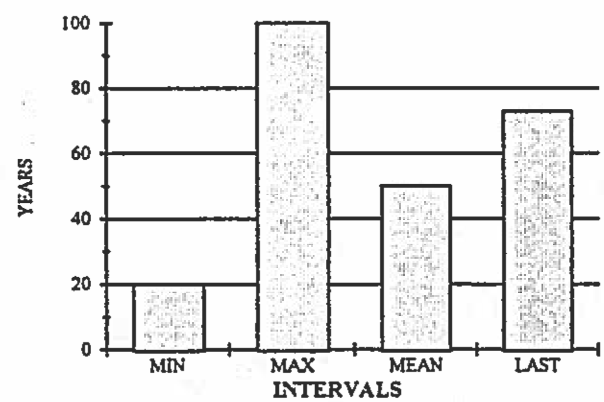


Fig. 2b. Area Fire History Statistics



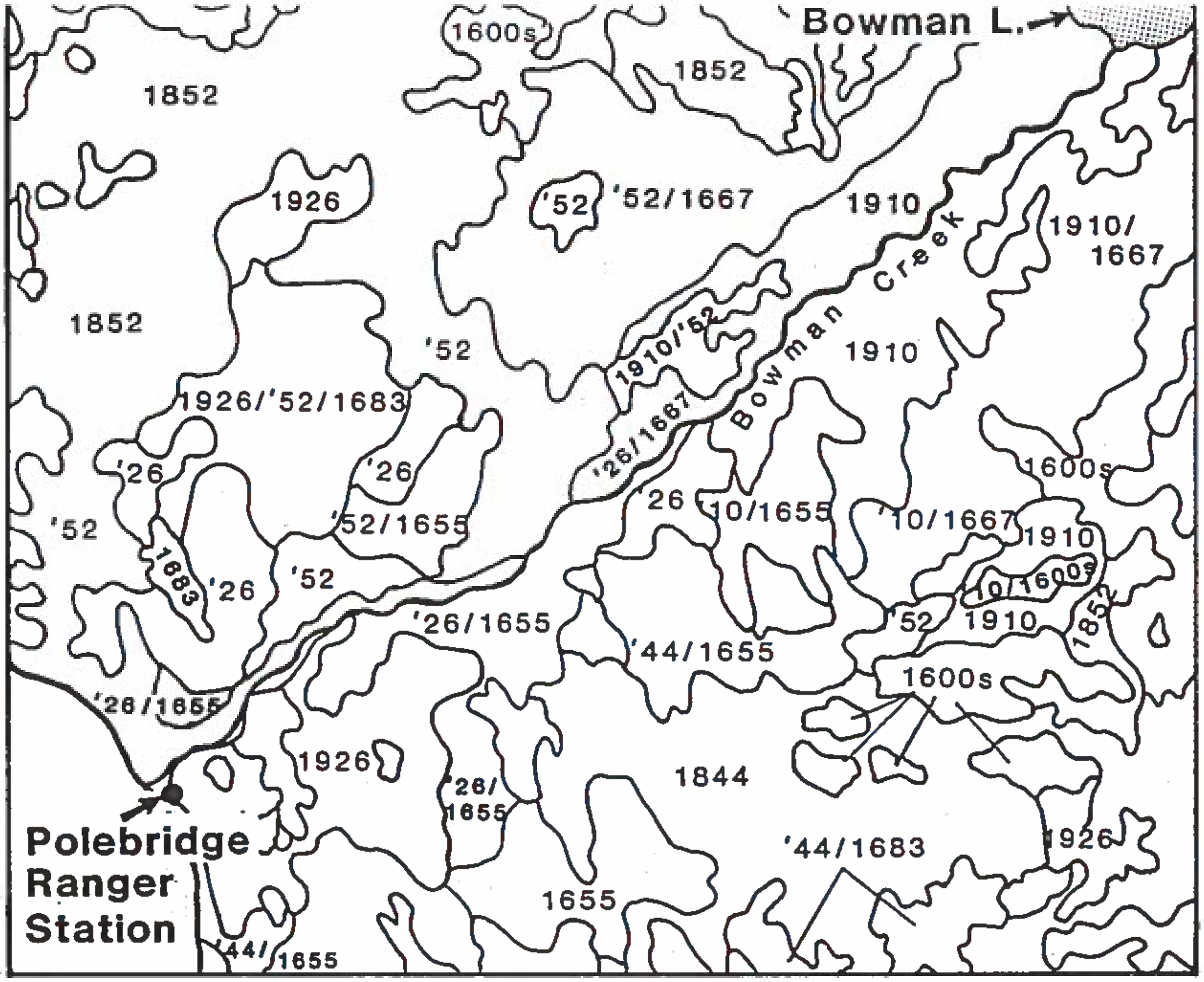

Bowman L.
1600s
1852
1852
1926
'52
'52/1667
1910
1910/
1667
Bowman Creek
1852
'52
1910/'52
1910
1926/'52/1683
'26/1667
'26
'26
1600s
'52
'52/1655
'26
10/1655
'10/1667
1910
1883
'26
'52
10/1600s
'52
1910
1852
'26/1655
'44/1655
'26/1655
1600s
1926
'26/
1655
1844
1926
Polebridge
Ranger
Station
'44/1683
1655
'44/1655

FIG. 3

0 2 km

(b)

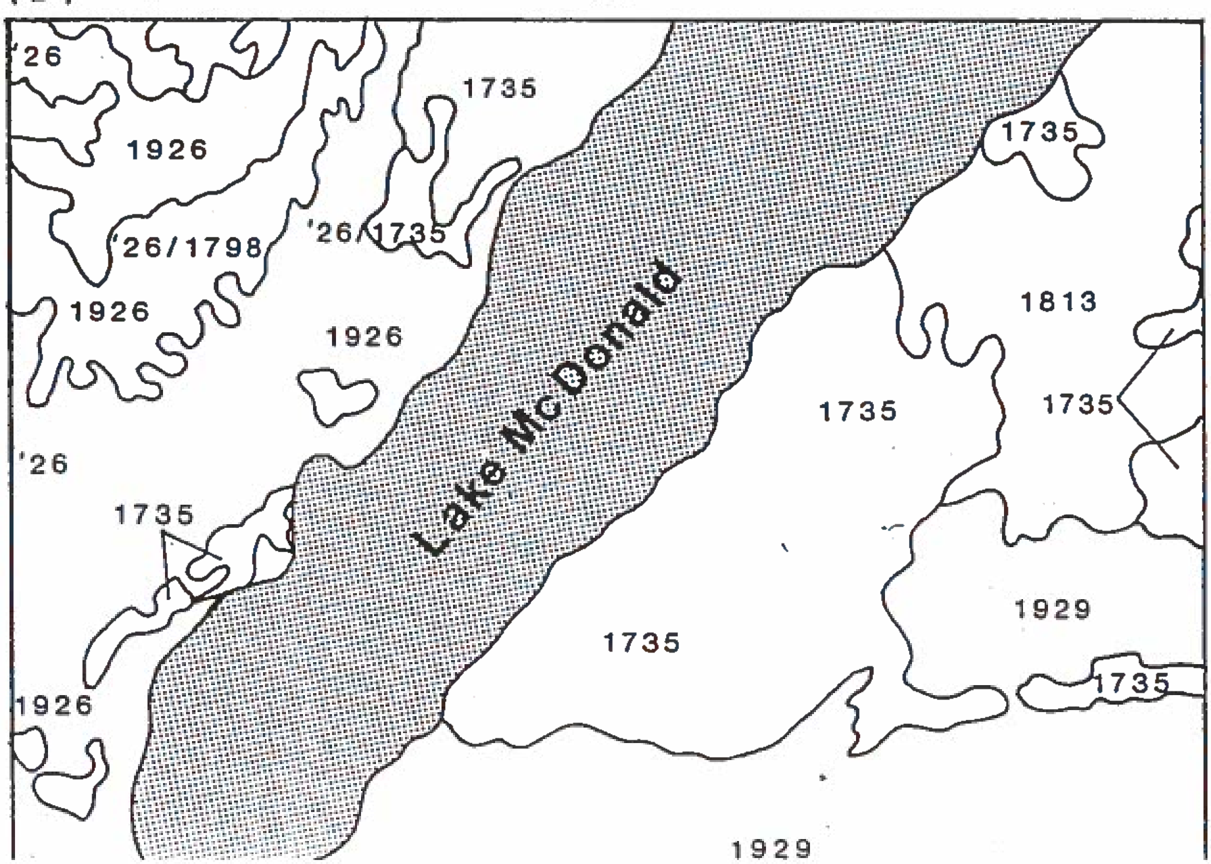

'26
1735
1926
1735
'26/1798
'26/1735
1926
1926
Lake McDonald
1813
1735
1735
'26
1735
1929
1735
1735
1926
1929

Table 1. Estimated Master Fire Chronology depicting stand replacing fires in a 4000 acre portion of the Upper Stryker Ridge Timber Sale, ca. 1730 to 1922 (seral age class data on file, DNRC; and samples from 2 stands on 2/12/96).

Plots

	I	II	III	IV	V	II b	VI	V b	VII	VIII	IX	X	XI	XI b	XII	XIII	#1	#16
1922				X														
1813									X			X		X				X
1792																		X
1756?	X	X			X		X	X									X	
1730	X		X		X	X	X	X	X	X	X		X	X	X	X		